HUMBOLDT BAY POWER PLANT

EVALUATION IN SUPPORT OF ALTERNATE WASTE DISPOSAL

PROCEDURES IN ACCORDANCE WITH 10 CFR 20.2002

1. INTRODUCTION

Pacific Gas and Electric Company (PG&E) requests NRC authorization for alternate disposal of certain low-activity waste containing byproduct and Special Nuclear Material (SNM) from its Humboldt Bay Power Plant (HBPP) Unit 3 Decommissioning Project. The authority of 10 CFR 20.2002 and the exemptions requested from 10 CFR 30.11 and 10 CFR 70.17 licensing requirements for byproduct material and SNM, respectively, would allow PG&E to transfer these wastes to the US Ecology Idaho, Inc. (USEI) facility for disposal. The USEI disposal facility is a Subtitle C Resource Conservation and Recovery Act (RCRA) hazardous waste disposal facility permitted by the State of Idaho and located near Grand View, Idaho.

Characteristics and operating parameters of the USEI disposal site are summarized in Section 2 of this Enclosure, with detailed information provided in Attachment 1 to this Enclosure. A description of the material to be disposed is included in Section 3. The material description includes physical and chemical properties of the material important to risk evaluation and the proposed conditions of waste disposal. Section 4 provides radiological assessments, including potential transport dose to the public, as well as USEI worker dose. A Criticality Safety Assessment performed for the USEI site is discussed in Section 5. The conclusion in Section 6 confirms doses will be well below NRC limits.

Attachment 2 provides MicroShield models and results pertaining to potential external and internal radiological dose hazards to USEI workers and transportation workers. Attachment 3 contains a summary of the RESRAD modeling assumptions used to calculate maximum dose projections, as well as copies of the code output files. Attachment 4 contains the inadvertent intruder analysis for the construction scenario consistent with the NRC's Request for Additional Information (RAI) on the Westinghouse Hematite project (Docket #070-00036). Attachment 5 contains the Waste Acceptance Criteria (WAC) set forth in USEI's permit issued by the Idaho Department of Environmental Quality. Attachment 6 contains the Criticality Safety Assessment for the USEI site that was performed as part of a prior alternate disposal application for the Westinghouse Hematite site.

2. DISPOSAL SITE CHARACTERISTICS

The USEI site is located in the Owyhee Desert of southwestern Idaho. It is at the end of Lemley Road, approximately 17 kilometers (10.5 miles) northwest of Grand View, (Owyhee County) Idaho. Grand View has a population of approximately 340. Owyhee County is a ranching and agricultural area of approximately 19,900 square kilometers (7,678 square miles). The county is sparsely populated, with an average population of 0.5 people per square kilometer (1.4 people per square mile per reference 7.1).

This region has an arid climate with an average annual precipitation rate of 7.4 inches. The USEI site is located on a 1.6 kilometer (1 mile) wide plateau. Maximum surface relief on the facility is 27 meters (90 feet) and the mean surface elevation is 790 meters (2,600 feet) above sea level. The nearest residence is 1.6 kilometers (1 mile) southwest of the site. There are no other land uses in the immediate vicinity of the site.

The NRC has granted USEI several 10 CFR 30.11 byproduct material exemptions and USEI was recently granted a 10 CFR 70.17 SNM exemption for purposes of disposal of various licensee waste streams. Based on the nature of the material, both a 10 CFR 30.11 byproduct material exemption and a 10 CFR 70.17 SNM exemption will be required.

The operational performance characteristics of the USEI site have been reviewed by the NRC and determined to be protective within the NRC's "*less than a few millirem (mrem) per year*" policy for Alternate Disposal Requests first stated in NRC Regulatory Issue Summary (RIS) 2004-08, "Results of the License Termination Rule Analysis," and reaffirmed in SECY-07-0060, "Basis for Justification and Approval Process for 10 CFR 20.2002 Authorizations and Options for Change."

A detailed description of the USEI facility is provided in Attachment 1 to this Enclosure.

3. DESCRIPTION OF THE WASTE

The subject waste consists of approximately 100,000 cubic feet (ft^3) of soil, concrete, steel, insulation, roofing material, gravel and other metal, wood, debris, and approximately 50,000 ft^3 (~400,000 gallons) of water associated with decommissioning of the deactivated HBPP Unit 3. The soil and debris waste will be generated from the demolition and dismantlement of HBPP Unit 3 structures and support components. Water shipments will include low-activity wastewater from HBPP Unit 3 operations that previously were discharged to the environment via the discharge canal. The wastewater will be solidified with clay at USEI and disposed as a soil-like waste. The liquid solidification process at USEI is routinely used for applicable shipments. All wastes are conservatively assumed to be transported over a minimum of two years.

The waste being considered under this request will include fission products, activation products, and SNM nuclides resulting from HBPP Unit 3 operations. The waste concentrations are expected to be very low as the majority will be surface-contaminated components or installed equipment that PG&E will choose not to decontaminate either during or after dismantlement. Overall, the soil and debris wastes will exhibit an average bulk density of 55 pounds per ft^3 (0.88 grams per cubic centimeter, g/cc), based on HBPP's waste packaging and shipping experience of similar waste streams. Water is assumed to have a density of 1.0 g/cc. Radiological characterization of the waste stream was performed through routine sampling and analysis of project waste materials as part of HBPP's 10 CFR 61 characterization program. A summary of the radionuclides and their concentrations are listed in Table 1 below.

A portion of the solid waste may be classified as RCRA hazardous due to the presence of metals (e.g., lead) in accordance with Environmental Protection Agency (EPA) Code D008. The USEI facility is permitted to accept D008 waste, as well as other RCRA metals, for treatment by encapsulation to meet EPA Land Disposal Restriction (LDR) requirements. Some asbestos containing material (ACM) may also be included.

Table 1- Radionuclides Potentially Present in HBPP Wastes

Nuclide	Concentration (pCi/g or pCi/ml)
Ag-108m	1
Am-241	10
C-14	2
Cm-243	2
Cm-244	2
Co-60	5
Cs-137	15
Eu-152	1
Eu-154	1
Fe-55	20
H-3	100
Ni-63	10
Pu-238	4
Pu-239	4
Pu-240	4
Pu-241	150
Sr-90	5
Tc-99	10
U-234	2
U-235	2
U-238	2

All shipments will have radioactivity concentrations well within the levels allowed in the site WAC set forth in USEI's permit issued by the Idaho Department of Environmental Quality (provided in Attachment 5). The actual concentrations in the water shipments will be reduced through the solidification process. These concentrations are also below levels requiring the waste to be classified as "radioactive material" for shipment purposes under U.S. Department of Transportation (DOT) regulations.

4. RADIOLOGICAL ASSESSMENT

As described in the following exposure scenarios, the dose equivalent for the Maximally Exposed Individual (MEI) has been demonstrated to not exceed "*a few mrem per year.*" The standard of a *"few mrem per year"* to a member of the public is set forth in NRC RIS 2004-08. The transportation workers and USEI workers are treated as members of the public because the USEI site, while permitted by the State of Idaho under RCRA to accept certain radioactive materials, is not licensed by the NRC.

External exposure assessments were performed using MicroShield Code, Version 7.02. Evaluations of potential external and internal dose hazards are discussed in the sections that follow and in Attachment 2. Table 2 of this enclosure is a summary of the total estimated doses for all transporters, as well as USEI workers performing surveying, handling, and disposal tasks on HBPP waste. Table 3 is a summary of the annual dose estimate for each worker group.

4.1. Transport Dose to the Public

All materials will be transported by truck to the USEI facility in Grand View, ID. For normal highway transport conditions, the soil and debris will be enclosed in IP-1 intermodal containers (IMC) loaded on chassis trailers, although some IMCs and oversized debris may be shipped on traditional flatbed trailers. Wastewater will be transported in tanker trailers with an approximate capacity of 5000 gallons. All conveyances will be verified to comply with DOT external loose surface contamination limits prior to shipment. Therefore, transport will not pose the potential for internal dose to the drivers or other members of the public.

The distance from HBPP Unit 3 to the USEI disposal facility is approximately 659 miles. Assuming an average speed of 50 miles per hour, the trip is estimated to take 13.2 hours. A minimum of eight trucks will be used to transport the entire volume of anticipated waste over the course of the project to achieve maximum logistical efficiency. Shipments are currently scheduled over a two year period to complete the project. Using a minimum of eight trucks, it will take approximately 125 IMC shipments (or 63 shipments per year) and 40 tanker shipments of water per year to complete the project. Each IMC truck driver is expected to make a minimum of 16 round trips between Eureka, CA and Grand View, ID over the course of the project, while each tanker driver is expected to make 10 round trips over the same route (or five trips per year). The soil/debris driver sits approximately 4 meters from the surface of an IMC with approximately 0.2 inches of aluminum shielding between the driver and the waste.

The tanker driver sits approximately 3.3 meters from the surface of the vessel with approximately 0.51 inches of steel shielding between him and the contaminated water. The tanker shielding includes the tank construction itself as well as outer steel liners.

Because of the very low average concentrations of radionuclides, external doses to the truck drivers are very low. As a result, the dose to other members of the general public can reasonably be concluded to be much less. External dose to a soil/debris truck driver (i.e., total dose) is estimated to be 0.16 mrem or 0.08 mrem/yr while external dose to a tanker truck driver is estimated to be 0.42 mrem or 0.21 mrem/yr.

4.2. USEI Worker Dose Assessment

Upon receipt at the facility, the material will be surveyed and screened prior to transporting the waste to the indoor stabilization facility on the USEI site. Five minutes is required to perform a survey of each truck. Based on current practice, a surveyor is assumed to stand at a distance of one meter from the truck or trailer during the survey, with four surveyors sharing the task. The survey crews will survey both the incoming IMCs and tanker trucks upon receipt at USEI, with the surveyor dose rates for the soil/debris trucks used for all workers, including those used for the tanker trucks, as they are higher by approximately 30%. External dose (i.e., total dose) to each surveyor is estimated to be 0.04 mrem, or 0.02 mrem/yr. There will be no additional dose to the HBPP shipment drivers from other trucks in the vicinity during the surveying, because the external dose rate from other trucks is negligible.

For the purposes of this assessment, it is conservatively assumed that all waste from HBPP Unit 3 will require treatment (for lead) or solidification (for incoming water shipments). In fact, as determined by HBPP through its waste analysis and characterization program, only a small portion of the soil and debris wastes (on the order of 10%) will require treatment. However, 100% of the water shipments will require solidification with clay soils within the USEI indoor stabilization building before burial in the landfill. After surveying, the waste is delivered to the stabilization building by the transport truck driver. The waste to be treated will be placed into a steel-lined concrete tank where it will be mixed with stabilization reagents. Wastes are wetted as they are emptied into the stabilization tank to reduce "dusting." The building is equipped with a negative pressure air handling system so that all air leaving the building is exhausted through High Efficiency Particulate Air (HEPA) filters. The stabilization process requires approximately 45 minutes, during which time the excavator operator, who is in an enclosed cab and wearing a respirator, is approximately 2.8 meters from the waste. Six operators share the stabilization task. External dose to each stabilization operator is estimated to be 0.03 mrem, or 0.016 mrem/yr.

Personnel who work in the stabilization building may also be exposed to airborne activity from "dusting." Significantly, all USEI employees who work with any hazardous materials are required to participate in an Occupational Safety and Health Administration (OSHA) compliant respiratory protection program. Although this proven form of protection is required, conservatively no credit is taken in the internal dose assessment. Stabilization building workers are also the maximally exposed individuals for inhalation dose, primarily because of the assumed exposure time (45 minutes) and the indoor environment. Internal dose to each stabilization operator is estimated to be .032 mrem, or .016 mrem/yr. Total dose is estimated to be .06 mrem, or .03 mrem/yr.

After stabilization, the excavator operator removes the treated waste from the stabilization tank and places it into an on-site haul truck for transport to the disposal cell for burial. After delivery to the disposal cell, a bulldozer operator wearing a respirator within an enclosed cab, spreads and compacts the waste. A minimal external dose is calculated for the two bulldozer operators who share the task of spreading and compacting the stabilized waste material once it has been deposited within the disposal cell.

The average time to spread and compact 50 tons of material (which is the capacity of 2.5 IMCs) is 15 minutes. This shorter exposure time results in less potential internal dose from airborne radionuclides than was calculated for an excavator operator. Personnel working in the disposal cells are also required to wear air purifying respirators at all times. Again, no credit is taken for this proven form of protection and internal dose is estimated to be the bounding dose calculated for a stabilization operator. The estimated total dose to each disposal cell operator is 0.05 mrem, or 0.025 mrem/yr.

Table 2 - Total Doses to Drivers and USEI Employees for HBPP Project

Function	No. Persons	Waste Contact Time (hr)	External Exposure Rate[1] (m rem/hr)	Internal Dose Rate (mrem/hr)	Dist. (m)	No. Trips or Reps	Total External Dose per Worker (mrem)	Total Internal Dose per Worker (mrem)	Total Project Dose per Worker (mrem)
IMC Truck Drivers	8[4]	13.2	7.63E-04	0.00E+00	4.0	125	1.57E-01	0.00E+00	1.57E-01
Tanker Truck Drivers	8[4]	13.2	3.20E-03	0.00E+00	3.3	80	4.21E-01	0.00E+00	4.21E-01
Survey Crews	4	0.08	8.68E-03	0.00E+00	1.0	200[2]	3.62E-02	0.00E+00	3.62E-02
Stab. Cell Workers	6	0.75	2.91E-03	2.95E-03	2.8	86[2,3]	3.13E-02	3.18E-02	6.31E-02
Waste Cell Operators	2	0.25	1.79E-03	2.95E-03	2.0	86[2,3]	1.93E-02	3.18E-02	5.11E-02

Notes: 1. All external dose rates calculated using MicroShield Version 7.02.
2. The additional volume from the water shipments are incorporated into the survey, stabilization, and landfill tasks.
3. It is assumed that the Stabilization and Waste Cell Operations will handle 50 tons of material at a time,
4. Assume the same 8 drivers so the doses are additive.

Table 3 - Annual Doses to Drivers and USEI Employees for HBPP Project

Function	No. Persons	Waste Contact Time (hr)	External Exposure Rate[1] (mrem/hr)	Internal Dose Rate (mrem/hr)	Dist. (m)	No. Trips or Reps	Annual External Dose per Worker (mrem)	Annual Internal Dose per Worker (mrem)	Total Annual Dose per Worker (mrem)
IMC Truck Drivers	8[4]	13.2	7.63E-04	0.00E+00	4.0	63	7.85E-02	0.00E+00	7.85E-02
Tanker Truck Drivers	8[4]	13.2	3.20E-03	0.00E+00	3.3	40	2.11E-01	0.00E+00	2.11E-01
Survey Crews	4	0.08	8.68E-03	0.00E+00	1.0	100	1.81E-02	0.00E+00	1.81E-02
Stab. Cell Workers	6	0.75	2.91E-03	2.95E-03	2.8	43[2,3]	1.57E-02	1.59E-02	3.16E-02
Waste Cell Operators	2	0.25	1.79E-03	2.95E-03	2.0	43[2,3]	9.67E-03	1.59E-02	2.56E-02

Notes: 1. All external dose rates calculated using MicroShield Version 7.02.
2. The additional volume from the water shipments are incorporated into the survey, stabilization, and landfill tasks.
3. It is assumed that the Stabilization and Waste Cell Operations will handle 50 tons of material at a time.
4. Assume the same 8 drivers so the doses are additive.

4.3. Post Closure Dose to the General Public

USEI's RCRA permit requires that it demonstrate that no person will receive an annual dose exceeding 15 mrem for 1,000 years after closure of the facility. This standard is more restrictive than the annual 25 mrem total effective dose equivalent (TEDE) stated in 10 CFR 20.1402 for NRC license termination, as well as the limits for near surface disposal of low-level radioactive waste set forth in 10 CFR 61. RESRAD code Version 6.5 was used for modeling the Grand View site for potential long-term post-closure doses. A number of default parameters in the Grand View model have been replaced with site specific parameters consistent with the facility's 2005 permit modification and a report prepared by its consultant (previously submitted to the NRC as part of an RAI response for the exemption request for the Westinghouse Hematite project, Docket #070-00036).

Two RESRAD models were run to assess the impact of the HBPP Unit 3 waste on the USEI site. The first model is consistent with USEI's post-closure dose model included in the Part B RCRA permit. This model assumes that all of the HBPP waste is distributed evenly within the contaminated zone (area = 88,221 m^2, depth = 33.6 m). The radionuclide concentrations in Table 1 are adjusted to reflect aggregation into the entire landfill volume, resulting in a dilution factor of 5.61E-04. All other RESRAD code parameters remain the same. The results of the first model show a maximum annual dose of 3.82E-02 mrem at approximately 246.9 years following closure of the facility. The RESRAD output report for this 'baseline' case is provided in Attachment 3.

The second RESRAD model is a postulated "concentrated burial" scenario, where all of the HBPP waste volume is buried within a much smaller portion of the landfill, resulting in less radioactive waste dilution from volumes of non-radioactive waste received concurrently at USEI. All of the HBPP waste in this submittal is assumed to arrive at USEI in a two month period, rather than two years. This assumption requires adjustment of the area and depth of the contaminated zone parameters in the RESRAD model to an area = 14,704 m^2 and a depth = 4.96 m. These values correspond to the relative portion of the USEI landfill expected to be utilized within a two-month shipping campaign. The 2831 m^3 of waste from HBPP is aggregated into a total landfill volume of 73,080 m^3, which includes all the waste received from other generators during that time (approximately one-sixth of an average 725,000 tons in a given year, or one sixth of the corresponding annual volume of 438,064 m^3), resulting in a dilution factor of 3.87E-02. The results of the concentrated model show a maximum annual dose of 1.59E-01 mrem at approximately 246.4 years following closure of the facility. The RESRAD output report for the 'concentrated' case is also provided in Attachment 3.

A post-closure inadvertent intruder construction scenario was conducted using the methods found in NUREG-0782, "Draft Environmental Impact Statement on 10 CFR Part 61 Licensing Requirements for Land Disposal of Radioactive Waste," and NUREG/CR-4370, Volume 1, "Update of Part 61 Impacts Analysis Methodology." No credit was taken for dilution of the radionuclide concentrations in these calculations, either in the buried concentrations themselves, as is done in the RESRAD model, or in the NUREG-0782 concentrations. The estimated inadvertent intruder dose rate for the nuclide concentrations in Table 1, without taking credit for dilution, is estimated to be 3.44 mrem/yr, which meets the NRC criterion *"few mrem per year"* for approval of a low level radioactive waste disposal exemption at an operating site and is well within the 10 CFR 20.1301 dose limit of 100 mrem/yr for individual members of the public from licensed operation.

A copy of the intruder spreadsheet is in Attachment 4.

5. CRITICALITY SAFETY

A Criticality Safety Assessment for the USEI site was performed as part of a prior alternate disposal application for the Westinghouse Hematite site (see Attachment 6). The "Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site, Rev. 2 (NSA, 2011)" verified that wastes containing U-235 may be sent to the USEI site for disposal since very large margins of safety had been incorporated into the normal operating conditions associated with these wastes and the probability for serious abnormal conditions is acceptably small. A maximum fissile concentration of 0.1 gram U-235 per liter of media was developed as an inherently safe concentration of SNM for the exhumed Hematite waste materials. This converts to an equivalent activity concentration of 216 pCi/g U-235 in soil (assuming a soil density of 1 g/cc). The U-235 activity concentration for this submittal (U-235 = 2 pCi/g as shown in Table 1) is at a significantly lower concentration than that previously shown to be inherently safe from a

criticality perspective. Therefore, it is not necessary to complete a new Criticality Safety Assessment for U-235 waste generated at the HBPP facility.

Mr. Herbert Cember published an inherently safe mass concentration for both U-235 and Pu-239 in reference 7.7, "Introduction to Health Physics, 3rd edition," of 11.94 g per liter (g/L) and 6.9 g/L, respectively, in aqueous solutions. These values are quoted for aqueous solutions, as they are the most favorable geometry for potentially achieving an inadvertent criticality event. They also represent a conservative application with respect to soils and debris waste streams that have far more void space in the shipping containers. The ratio of these values can be used to derive a reasonable estimate of the Table 1 activity concentration of Pu-239 (4 pCi/g) in terms of an equivalent U-235 activity concentration; combining the calculated result of 6.9 pCi/g with the Table 1 activity concentration of U-235, gives 2 pCi/g + 6.9 pCi/g = 8.9 pCi/g equivalent U-235, which is well less than the inherently safe value of 216 pCi/g.

The SNM potentially present in this request for alternate disposal (U-235 + Pu-239) is at significantly lower concentrations than those analyzed to be inherently safe from a criticality perspective for disposal at USEI. Therefore, it is not necessary to implement criticality safety procedures for shipments of HBPP wastes slated for disposal at USEI.

6. CONCLUSION

PG&E developed this request and related evaluation in consultation with USEI, including health physics personnel responsible for the Grand View disposal facility's waste acceptance and radiological performance assessment programs. This assessment team performed a radiological dose assessment of the material to be shipped and determined that the potential dose to the workers involved in the transportation and placement of the material and to members of the general public after site closure is less than one mrem per year TEDE. This dose is a small fraction of the NRC decommissioning limits for exposure to any member of the public of 25 mrem/yr TEDE, and is well within the "*few mrem per year*" criterion that the NRC has established in RIS 2004-08.

The total doses to an individual worker for this exemption request and the two previous requests are bounded by the total number of shipments that can realistically be made in one year and the maximum dose for these shipments. For this exemption request, the maximum number of annual shipments that can be made with eight drivers is 400 shipments. Of the these shipments, it is anticipated that there will be a maximum of 60 water shipments and 340 soil/debris shipments in a single year. The highest dose for the water shipments then becomes approximately 0.30 mrem. The maximum dose from the 340 soil/debris shipments is also approximately 0.30 mrem. Therefore, the anticipated maximum dose to the truck drivers would be approximately 0.60 mrem. Adding more shipments would result in more drivers and therefore more shipments would not increase the dose per driver. Because the estimated doses to other workers involved in the disposal are less than a driver's dose, the doses to the other workers would be less than a few millirem/yr.

7. REFERENCES

7.1 American Geotechnics, "Hazardous Waste Facility Siting License Application Cell 16," Project No. 06B-C1202, June 30, 2006, ML 100320540, Attachment 7.

7.2 Nuclear Safety Associates, "Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site, Rev. 2." NSA-TR-09-14. December 2011.

7.3 US Ecology Idaho, Inc. USEI Site B Permit No. IDD073114654. 2004

7.4 U.S. Environmental Protection Agency, Federal Guidance Report No. 11. "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion." EPA-520/1-88-020. US EPA Office of Radiation Programs. September 1988.

7.5 U.S. Nuclear Regulatory Commission, Regulatory Issue Summary 2004-08, "Results of the License Termination Rule Analysis." Office of Material Safety and Safeguards. May 28, 2004

7.6 U.S. Nuclear Regulatory Commission, "Basis and Justification for Approval process for 10CFR20.2002 Authorizations and Options for Change." SECY-07-0060. Division of Waste Management and Environmental Protection. March 27, 2007.

7.7 Introduction to Health Physics, 3rd edition; Herbert Cember; January, 1996.

Attachment 1
USEI Site Description

Environmental conditions at USEI's site are well-documented in previous submittals to the USNRC, most recently as part of the Westinghouse exemption request for the Hematite, Missouri project (Docket # 07000036).

In compliance with the requirements of 10 CFR 20.2002, two key documents are attached herein.

- Exhibit A: *Hazardous Waste Facility Siting License Application for Cell 16* (American Geotechnics, dated June 30, 2006); This document describes US Ecology Idaho's environmental setting and was accepted by the Idaho Department of Environmental Quality as part of the 2005 siting process, which resulted in IDEQ approval (December 6, 2006) of USEI's request to expand its landfill operations.

- Exhibit B: *Summary of Hydrogeologic Conditions and Groundwater Flow Model for US Ecology Idaho Facility, Grand View, Idaho* (Eagle Resources, dated January 13, 2010); This document provides a detailed description of site geology and hydrogeology.

Attachment 1
Exhibit A
Hazardous Waste Facility Siting License Application for Cell 16

(126 pages)

Attachment 1
Exhibit B
Summary of Hydrogeologic Conditions and Groundwater Flow Model for US Ecology Idaho Facility

(36 pages)

Attachment 2
External and Internal Dose Evaluations
Case Summaries and Input Parameters, MicroShield® Ver. 7.02
(12 pages attached to this cover sheet)

A. MicroShield Source Term Data

Isotope	Waste Stream Concentration (pCi/g)	µCi/cm^3 Input for MicroShield® [1]
Ag-108m	1	8.80E-07
Am-241	10	8.80E-06
C-14	2	1.76E-06
Cm-243	2	1.76E-06
Cm-244	2	1.76E-06
Co-60	5	4.40E-06
Cs-137	15	1.32E-05
Eu-152	1	8.80E-07
Eu-154	1	8.80E-07
Fe-55	20	1.76E-05
H-3	100	8.80E-05
Ni-63	10	8.80E-06
Pu-238	4	3.52E-06
Pu-239	4	3.52E-06
Pu-240	4	3.52E-06
Pu-241	150	1.32E-04
Sr-90	5	4.40E-06
Tc-99	10	8.80E-06
U-234	2	1.76E-06
U-235	2	1.76E-06
U-238	2	1.76E-06

[1]Input concentrations for MicroShield® are adjusted for expected density of the matrix (0.88 g/cc).

B. Summary of MicroShield® Runs

Job Function	Description	Dose Conversion Factor (mrem/hr per µCi/cm^3)
Truck Drivers	4 m from surface of IMC (8'x20'x5') on loaded chassis trailer. 0.5 cm Al shield	1.33E-06
Truck Surveyors	1 m from truck bed (8'x20'x5'), centerline – front, 0.5 cm Al shield	2.17E-05
Treatment Workers	2.8 m above corner of rectangular stabilization pit (12.5'x12.5'x12.5'). No shielding	9.89E-06
Landfill Cell Operators	2 m from slab source (3'x6'x12.5') with 1.25 cm Fe shield	4.48E-06

Attachment 3
RESRAD Ver. 6.5 Input Parameters and Case Files
(pg. 1 of 3)

Calculation of RESRAD Concentrated Model Input Parameters

#	Parameter or Assumption	Value	Unit
A	Assumed Timeframe to Complete Project	2	months
B	Total HBPP Waste Volume	100,000	ft^3
		3703.7	cy
		2831.7	m^3
C	HBPP Waste Density	55	lb/ft^3
		0.88	g/cc
D	Mass of HBPP ADR#3 Waste Stream	5,500,000	lb
		2,750	tons
E	Average Annual Waste Received at USEI	725,000	tons
F	Average Monthly Waste received	60416.7	tons
G	Density of USEI waste cells (in situ)	1.5	g/cc
		1.65	$tons/m^3$
H	Baseline RESRAD USEI Contamination Zone Area	88,221	m^2
I	Baseline RESRAD USEI Contamination Zone Depth	33.6	m
	Equations and Calculations		
J	Surface area for concentrated HBPP waste in USEI Landfill [= H/6]	14703.5	m^2
	(total area divided by 6 - for 2 month burial period)		
K	Volume of Total USEI Waste Received in 2 months [= E/(6*G)]	73080	m^3
	(mass in tons converted to *in situ* m3)		
L	Dilution Factor for Concentrated HBPP Waste Stream [= B/K]	3.87E-02	
	(volume of HBPP ADR #3/Volume of USEI 2-month total)		
M	Thickness of CZ in Conc. RESRAD Model [= K/J]	5.0	m

Attachment 3
RESRAD Ver. 6.5 Input Parameters and Case Files
(pg. 2 of 3)

Resulting Radionuclide Input Values for Concentrated RESRAD Model

Isotope	Concentrations (all values in pCi/g)		
	Shipped	Modeled (Baseline)[a]	Modeled (Concentrated)[b]
Ag-108m	1	8.79E-04	3.87E-02
Am-241	10	8.79E-03	3.87E-01
C-14	2	1.76E-03	7.75E-02
Cm-243	2	1.76E-03	7.75E-02
Cm-244	2	1.76E-03	7.75E-02
Co-60	5	4.40E-03	1.94E-01
Cs-137	15	1.32E-02	5.81E-01
Eu-152	1	8.79E-04	3.87E-02
Eu-154	1	8.79E-04	3.87E-02
Fe-55	20	1.76E-02	7.75E-01
H-3	100	8.79E-02	3.87E+00
Ni-63	10	8.79E-03	3.87E-01
Pu-238	4	3.52E-03	1.55E-01
Pu-239	4	3.52E-03	1.55E-01
Pu-240	4	3.52E-03	1.55E-01
Pu-241	150	1.32E-01	5.81E+00
Sr-90	5	4.40E-03	1.94E-01
Tc-99	10	8.79E-03	3.87E-01
U-234	2	1.76E-03	7.75E-02
U-235	2	1.76E-03	7.75E-02
U-238	2	1.76E-03	7.75E-02

[a]Modeled Conc. = Shipped Conc. × Baseline DF (5.61E-04)
[b]Modeled Conc. = Shipped Conc. × Concentrated DF (3.87E-02)

Attachment 3
RESRAD Ver. 6.5 Input Parameters and Case Files
(pg. 3 of 3)

An electronic file has been emailed to the NRC on July 6, 2012 containing the following information:

pp. 1-55 : Summary Report (Part I) for the Baseline RESRAD case.
pp. 56-331 : Detailed Report (Part II) for the Baseline RESRAD case.
pp. 332-386 : Summary Report (Part I) for the Concentrated RESRAD case.
pp. 387-662 : Detailed Report (Part II) for the Concentrated RESRAD case.

Attachment 4
Inadvertent Intruder Calculations
Construction Scenario

Attachment 5
USEI Part B Permit EPA ID. No.: IDD073114654
Revision Date: September 25, 2008
Part C.3 WASTE ACCEPTANCE CRITERIA

(5 pages)

Attachment 6
Nuclear Criticality Safety Assessment of the US Ecology Idaho (USEI) Site for the Land Fill Disposal of Decommissioning Waste from the Hematite Site, Rev. 2." NSA-TR-09-14. December 2011

(75 pages)